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TRAFFIC ENHANCEMENT STUDY

Savannah, Georgia

Phase I

Floating Vehicle Data Analyses

by

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September 25, 1973

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TABLE OF CONTENTS

A. Purpose and Intent

1. The purpose of this report is to present the results and conclusions of a floating vehicle study performed on the surface streets of Savannah, Georgia. The analyses are directly applicable to the peak AM and PM periods of travel. The results are presented as vehicle operation costs (road-user costs) and congestion costs for each specified interval of the several streets.

2. In addition to the cost analyses, arguments and conclusions are presented with respect to the procedures utilized to obtain accurate and objective results. Also, projected cost benefits are developed which might be realized subsequent to implementation of the computerized traffic control system.

B. Background Information

1. The total costs for vehicle operations on surface streets are affected by many different variables. Perhaps the most comprehensive survey of these variables and their relative magnitudes is given in R. Winfrey's textbook, "Economic Analysis for Highways", International Textbook Company, 1969. The results of this report have been based on the appropriate values of the variables and on the procedures indicated in this reference.

2. Generally, the floating vehicle study area is bounded on the north by Bay Street, on the south by Victory Drive, on the west by West Broad Street, and on the east by Waters Avenue. The traffic control project includes a somewhat larger area, but the above listed boundaries contain the principal flows, congestions, etc.

3. The floating vehicle concept involves the use of a suitably equipped vehicle which is driven over specified surface street intervals during some desired time of observation. This has been accomplished with a 1973 Dodge Polara equipped with an Argo-Kienzle Tachograph, calibrated together with the vehicle odometer. This tachograph provides a circular chart recording of all vehicle speeds according to the lapsed time. Minimum resolutions are approximately $\pm$ 1 mph and $\pm$ 1 sec. One "loading" of charts provides about 168 minutes of continuous recording time.

4. The analogue form of the chart recorded data must be transcribed to digital form for data analyses. The analyses may be accomplished by hand calculations or by computer calculations. A computer program entitled RUNCOST is available at Georgia Tech, and can be utilized for

data analyses. This program has been developed by the Federal Highway Administration, and it is based on the variables and procedures contained in the previous reference (paragraph 1 above). The program is particularly useful with large data banks where street grades and curvatures exist and where different types of truck traffic volumes are significant.

5. It is noted, however, that the analyses of this report have been accomplished by hand calculations. This has resulted because the initial allocated funds were expended during the floating vehicle study; therefore, there were no funds available for explicit computer usage at the time that these analyses were accomplished. This requirement for hand calculations has not contributed significantly to the costs of personal services for these analyses. There are several reasons for this circumstance.

a. The transcription of chart data to digital data requires a time-consuming effort and must be accomplished whether hand calculations or computer calculations are realized.

b. For the Savannah traffic environment, there were no calculations necessary for the cost effects of street grades and curves. Also, there were no calculations for the cost effects of truck traffic, since measured truck volumes for the peak periods were not sufficient to warrant consideration.

c. Finally, the accomplishment of hand calculations has produced some interesting and perhaps useful results with respect to the procedures utilized in obtaining vehicle operation costs. These results are discussed below in Section D.

6. The floating vehicle data for this report were obtained during the AM and PM peak periods of traffic flow from Monday, June 11, through Friday, June 15, and from Monday, June 25, through Friday, June 29. Usually, a number of separate runs were accomplished successively for each street interval in an attempt to "bracket" the peak period flows. The extent of street coverage was greater than that actually required for a minimal data base. The following street intervals were included in the floating vehicle study.

a. West Broad, north and southbound (Bay - Victory)

b. Montgomery, northbound (Exchange to Bay) and southbound (Gaston to Victory)

c. Whitaker, southbound (Bay to Victory)

d. Drayton, northbound (Victory to Bay)

e. Abercorn, north and southbound (Bay - Victory)

f. Price, southbound (Bay to Victory)

g. East Broad, northbound (Victory to Bay), and southbound (Bay to Liberty)

h. Waters, north and southbound (Wheaton - Victory)

i. Wheaton, northwest and southeast bound (E. Broad - Waters)

j. Bay, east and westbound (East Broad - Fahm)

k. Oglethorpe, east and westbound (West Broad - East Broad)

l. Liberty, east and westbound (West Broad - East Broad)

m. Henry, westbound (Waters to West Broad)

n. Anderson, eastbound (West Broad to Waters)

o. 37th, east and westbound (West Broad - Waters)

p. Victory, east and westbound (West Broad - Waters)

7. Because of time and cost limitations, all of data obtained from the above listed streets have not been analyzed. However, as discussed prior to the initiation of this study, all major street intervals have been included. These comprise Bay, West Broad, Montgomery, Whitaker, Drayton, Price, Victory, and Waters. Other streets have been included also, where significant congestions were observed.

8. On some particular street intervals, a number of runs were accomplished. These included successive runs during the same peak period on a given day, and also included runs accomplished on other week days. For these cases, however, only one or two runs have actually been completely analyzed to the extent of calculation of vehicle operation costs. That is, all runs were examined in detail, including stopped times, travel times, and floating vehicle speeds; then one or two "typical" runs were analyzed for vehicle operation costs and congestion costs.

9. Finally, directional vehicle volume counts were obtained for the several street intervals during the time of the runs. The specific applications of these data are discussed in the following section, paragraph 9.

C. General Discussions

1. There are several terminologies used in the development of vehicle operation costs which should be defined and discussed. Most floating vehicle studies are performed for the purpose of comparing the results of traffic flow which are obtained "before" and "after" the implementation of some project designed to improve traffic flow. The "improvement" is often measured as a cost benefit of the project. The vehicle operation costs are calculated from the "before" and "after" data banks, and the cost benefit is calculated as the difference in these operation costs. Therefore, cost benefit for any particular street interval (or for a system of streets) is defined as the difference in vehicle operation costs, resultant from the before and after studies. Sometimes, a total cost benefit is calculated; it is simply the product of the cost benefit for the floating vehicle and the volume of vehicles on the street interval (or, system of streets).

2. Some evaluating agencies utilize the vehicle time-delay concept in obtaining vehicle operation costs. That is, the time of travel of the floating vehicle from point A to point B is measured; this time is then multiplied by a time-cost parameter to obtain the time cost of the run. The value of the time cost is then assumed to be the vehicle operation cost for the run. The time-cost parameter (utilized in obtaining the time cost) represents an accessed value of the occupant's time, multiplied by the number of occupants in an average vehicle during the period of observation. Therefore, the time cost of vehicle operation is defined

as the product of the time extent of a floating vehicle run (measured in seconds) and the time-cost parameter (measured in $/sec). It is obvious that this method of calculating vehicle operation costs ignores the actual expenses incurred in the "running" of the vehicle itself, such as gasoline, oil, maintenance, depreciation, and the costs associated with any changes in vehicle speed.

a. The particular value of the time-cost parameter which should be utilized is a controversial subject. According to prior literature studies, the dollar value of an occupant's time has been accessed as $1.50 per hour. Also, for peak period travel, the average vehicle is assumed to contain 1.6 occupants. Thus, the value of the time-cost parameter is $2.40/hr, or $0.00067/sec. This value has been used in some of Winfrey's examples in his textbook, and it is the value utilized in this report. Therefore, the time cost item of vehicle operation cost may be further defined as the product of $0.00067/sec and the time extent of the floating vehicle run. Time cost may be expressed as $/run or as $/vehicle mile (VM).

b. A generalized value for the time-cost parameter may constitute an ill-advised usage in this author's opinion. It would appear more definitive to access a value which is related to income levels, which may vary for different communities and, in particular, may vary for different work-trip routes within a community.

c. More recent data on the value of an occupant's time have been supplied by P. A. Parsonson, Civil Engineering Department, Georgia

Institute of Technology. Dr. Parsonson indicates a value of $3.00 per hour for the occupant's time, with an average of 1.6 occupants per vehicle, or a time-cost parameter of $4.80/hr, or $0.00133/sec. He also recommends an "across the board" increase of 20% in Winfrey's table values.

3. It is maintained by this author that all cost items must be included in accessing an accurate and objective value of vehicle operation cost, as well as for subsequent calculations of the cost benefit. A specific example from the Savannah data will indicate these cost items, as well as illustrate the recommended procedures for obtaining total vehicle operation costs.

a. A typical southbound PM run on West Broad Street, between Bay and Anderson, required 482 seconds to traverse the distance of 7137 feet (1.35 miles).

b. The time cost of the run is $0.3229/run, or $0.2392/VM. This results from the product of 482 seconds and $0.00067/sec.

c. From the tachograph chart data for the run, the average floating vehicle speed for each two second interval of the run was determined. From Winfrey's tables, the cost for each of these average speeds was summed (each average speed being considered as a uniform speed for the descrete time interval). The resultant vehicle run cost was obtained as $0.0516/run.

d. Also from the tachograph chart data, each incremental floating vehicle speed change for the entire run was determined. From Winfrey's tables, the associated cost for each speed change was summed. The resultant vehicle change speed cost was obtained as $0.0618/run.

e. The sum of items c and d above constitutes the estimated cost of vehicle movements during the run, which is equal to $0.1134/run.

f. The sum of items b and e above constitutes the total estimated vehicle operation cost for the run, which is equal to $0.4363/run.

4. The data analyses of the preceeding paragraph indicate several significant features. Aesthetically speaking, if the commuting public were truly aware of their individual costs for vehicle operations on congested surface streets, it is believed that significant improvements would be demanded. Technically speaking, the data indicate the following.

a. The magnitude of the vehicle movement cost (run cost plus speed change cost) constitutes a significant percentage of the time cost. For the example cited, the vehicle movement cost ($0.1134) is about 35% of the time cost ($0.3229). For all of the analyzed data for Savannah, the vehicle movement costs average about 44% of the corresponding time costs, with variations from 14% to 67%. Also, other data from intervals of Atlanta expressway travel indicate vehicle movement costs which exceed the time costs. (See, for instance, "A Feasibility Study of a System for Monitoring the Road-User Cost of Urban Traffic Congestion", P. A. Parsonson, Contract Research, Georgia Highway Department, Project #70004). Consequently, it is concluded that vehicle movement costs are not an insignicant part of the vehicle operation cost.

b. The magnitude of the vehicle change speed cost constitutes a significant part of the vehicle movement cost. For the example cited, the change speed cost ($0.0618) is greater than the run cost ($0.0516).

For all of the Savannah data, the magnitudes of these two cost items are about equal. Therefore, when traffic improvements are realized, a smoother flow usually results, together with a smaller number of speed changes. Consequently, there can be significant changes in the vehicle movement costs as a result of improved traffic controls.

c. It should be noted that the relative magnitudes of the various cost items mentioned above would not be seriously altered, if the "updated" values (paragraph 2c above) were utilized. The net effect for the Savannah data would be an increase in the time cost by a factor of 2, and an increase in the vehicle movement costs by a factor of 1.2. On the average, the magnitude of the vehicle movement costs would still constitute a value which is 26% of the time costs.

5. Before comparisons can be made with respect to the different procedures for obtaining cost benefits, several more terms need definition. The Highway Capacity Manual, 1965 (National Research Council, Highway Research Board, Special Report #87) indicates a "standard" speed of 20 mph for surface streets in central business districts (CBD). Thus, a uniform speed of 20 mph is assumed, i.e., there are no stops. At 20 mph, a vehicle traverses a distance of one mile in 180 seconds. Therefore, the standard time cost is defined to be the product of 180 seconds and \$0.0067/sec, or \$0.1206/VM. From Winfrey's tables, the cost item for operation of a vehicle at a uniform speed of 20 mph (no stops) for 180 seconds is \$0.0371/VM. Therefore, the total standard vehicle operation cost is defined to be \$0.1577/VM, which is the sum of the time cost

($0.1206) and the movement cost ($0.0371). For the West Broad Street example cited above, the standard vehicle operation cost is $0.2129/run, which is the product of the standard cost per mile and the mileage of the run.

6. The congestion cost is a descriptive term which may be utilized as a measure of the cost penalty incurred by a vehicle moving on contested streets. Congestion cost is defined as the difference between the actual (total) vehicle operation cost and the standard vehicle operation cost. (This usage has been developed by Dr. Parsonson). For the West Broad Street example, the congestion cost is $0.2234/run, which is the difference between the actual operation cost ($0.4363/run, paragraph 3f above) and the standard operation cost ($0.2129/run, paragraph 5 above).

7. It is now possible to re-examine the procedures utilized to obtain cost benefits. Since cost benefit necessarily involves the data resultant from an "after" study, and since the "after" study for Savannah has not yet been performed, an example of an improved traffic flow on West Broad will be assumed. Let it be supposed that the floating vehicle accelerates from 0 mph to 20 mph at the Bay Street intersection and proceeds to the Anderson Street intersection at a uniform speed of 20 mph, except that one 20 second stop may be required somewhere within the interval. (This is certainly a realistic assumption for the cited example, and it should be realizable as a result of the implementation of the computerized traffic control system).

a. The assumed accelerations and decelerations amount to an average speed of 10 mph for three intervals of 8 seconds each, i.e., initial

acceleration from 0 mph to 20 mph, deceleration from 20 mph to 0 mph for the stop, and acceleration from 0 mph to 20 mph. From Winfrey's tables, the cost of these speed changes is $0.0074.

b. The distance traversed during the above speed changes is about 352 feet, which leaves about 6785 feet to be traversed at 20 mph. The time required for this latter movement is 231.3 seconds. From Winfrey's tables, the cost of this vehicle movement is $0.0477. From Winfrey's tables, the cost of the 20 second stop (idle engine) is $0.0006. Also, from Winfrey's tables, the cost for vehicle movement at 10 mph for 24 seconds is $0.0030. Therefore, the vehicle run cost is $0.0513.

c. The time cost includes 24 seconds at 10 mph, 20 seconds at 0 mph, and 231.3 seconds at 20 mph, or a total of 275.3 seconds. Therefore, the time cost is $0.1845/run, or $0.1367/VM.

d. The total vehicle operation cost for the assumed run is the sum of items a, b, and c above, or $0.2432/run, or $0.1801/VM.

8. It has been stated that other evaluating agencies compute vehicle operation costs based solely on the item of time cost. Consequently, the calculated cost benefit would be the difference in the time costs resultant from the before and after studies. For the above example the "before" time cost is $0.2392/VM (paragraph 3b above). The "after" time cost is $0.1367/VM (Paragraph 7c above). Thus, the calculated cost benefit would be $0.1025/VM or $0.1384/run. On the other hand, if the cost benefit is obtained from the total vehicle operation costs (according to the above described procedures), this cost benefit is $0.1430/VM or $0.1931/run. Therefore, it should be obvious that cost benefit calculations should be based on <u>total</u> vehicle operation costs.

a. The difference in the above two cost benefit calculations is $0.0547/run. When the average peak period volume of 818 veh/hr is considered for this interval, a yearly difference of $11,634 is obtained between the two cost benefit calculations. Certainly, this value cannot be considered as being insignificant.

b. The cost congestion for the above assumed traffic flow improvement is $0.0303/run. (This is the difference between the standard cost, paragraph 5 above, and the operation cost for the improved run, paragraph 7d above). The previous congestion cost (paragraph 6 above) was $0.2234/run. Therefore, the improvement in the congestion cost (resultant from the assumed run) is about 86%.

9. Finally, several observations are made with respect to vehicle volume count data as they relate to the analyses of this report. For the Savannah traffic environment, the peak period volume counts generally indicate significant variations along the street interval for any particular floating vehicle run. For instance, for southbound PM flow on West Broad, the volume count just south of Bay is about 500v/hr, while the count at Gwinnett is about 1200 v/hr. Similar variations were evidenced along Whitaker, Drayton, Price, Bay, and Victory, dependent on the sub-interval chosen.

a. First, it must be realized that the floating vehicle runs were accomplished (as requested) over specified intervals of the surface streets, for instance, on West Broad from Bay to Victory. Therefore, any given peak period floating vehicle run will be representative of travel over the total interval, and, of course, would be affected by the various volume

distributions of other vehicles throughout the interval. The point to be made is that the calculated vehicle operation costs (and congestion costs) relate to travel over the entire street interval; they are not obtained on a block-by-block basis. It should be mentioned that this procedure does not preclude a subsequent block-by-block analysis; rather it is noted that such an extensive analysis would require more time and effort. Nevertheless, there do exist several cases where particular congestions were observed on sub-intervals of different street runs, and some of these sub-intervals have been analyzed.

b. Second, it should be noted that the floating vehicle runs are representative of travel along a specified street interval and, at the same time, may or may not represent a particular work-trip route. For instance, there are a number of "dog-leg" traffic movements for ingress and egress of the CBD area. There also exist a number of distribution areas, i.e., not distribution points, where traffic may disperse from a street or where traffic may begin to build up. For instance, a well-known work-trip route follows Abercorn northbound to Victory, "dog-legs" to Drayton, and proceeds northbound on Drayton into the CBD area. However, the dispersion of vehicles from Drayton, northbound from Anderson to Bay, is rather dramatic. From about 1400 veh/hr north of Victory, the volume reduces to about 300 veh/hr at Bay. Of course, this is to be expected for the Savannah traffic environment. However, the question still may arise as to the appropriate magnitude of vehicle counts to be utilized for the run. This problem has been handled in the following manner. For any given street interval there usually exist data from several vehicle counting stations along the interval. From the

count data recorded at these several stations, an average peak volume count was obtained by simple arithmetic average, i.e., the total of all counts for one direction of flow in the interval, divided by the number of counting stations. The resultant average volumes have been recorded on each data sheet for the several runs.

c. Third, it is noted that specific work-trip routes have not been analyzed. This results because there are no available data on specific work-trip routes or for the volumes of vehicles associated with the various work-trip routes. Nevertheless, the data bank which has been obtained is sufficient to permit a more detailed analysis for any particular specified work-trip route, if this type of analysis is desired.

d. Finally, it is noted that directional counts were obtained on the several street intervals during the times of the floating vehicle runs. However, the data obtained are rather limited because the City of Savannah could supply only seven counters for this purpose, and, of these, only four counters yielded consistent results because of counter malfunctions. As a result of these circumstances, the volume count data obtained during the floating vehicle study have been utilized only to the following extent. For any given run, the recorded volume count was examined to "document" the fact that the magnitude of the count was "normal" as compared to previously obtained and extensive TOPICS data. These procedures do not place any significant constraints on the reported vehicle operation costs for the various runs. This results because all of the measured flows are quite stable and appear to be reproducable from day to day, for the same peak period and for the same street interval. Of course, all of the "raw" data have been preserved so that re-evaluations are possible at any subsequent time if such is desired.

D. Data Analyses for Vehicle Operation Costs

1. As mentioned previously, the data analyses were accomplished by hand calculations. In order to obtain accurate reproductions of the floating vehicle movements, the tachograph chart data were examined in detail, every two seconds of lapsed time. (It is noted that such detailed analyses are not considered to be practical for computer applications because of the excessive increase in card punch time and computer run time).

2. The vehicle operation costs for eighteen example runs were accomplished by the above detailed procedures. The resultant calculated vehicle operation costs have been listed in the Appendix data sheets as detailed vehicle operation costs. The reason for this connotation is discussed as follows. It became apparent that such detailed analyses for each run were rather tedious and time consuming. Therefore, a simpler procedure was sought. For the eighteen example runs, two auxiliary calculations were accomplished as follows.

a. Instead of obtaining detailed average speed listings for each two second interval of a run, the average speed of the total run was utilized. This value can be determined rapidly from the tachograph chart data; it is the distance of the run divided by the time extend of the run. From Winfrey's tables, the run cost for this average (uniform) speed was determined and listed on the data sheets as the average vehicle run cost.

b. Instead of obtaining each discrete speed change listing from the tachograph chart data, only the more gross speed changes were considered,

i.e., equal to or greater than 5 mph. Such speed changes also can be determined rapidly from the chart data. From Winfrey's tables, the associated costs for these speed changes were determined and listed on the data sheets as the average vehicle change speed cost.

c. The above items a. and b. are then added to the time cost, and the summed result is listed on the data sheets as the average vehicle operation cost.

d. It happens for the Savannah data, that the average vehicle operation costs for the eighteen example runs provide a rather close approximation to their corresponding detailed vehicle operation costs. For instance, the average difference between the two costs is only $0.0044/VM, with a maximum variation of $0.01/VM, which occurs for only one of the eighteen examples.

3. As a result of these comparisons, it is considered fortuitous that the hand calculations were accomplished. It is believed that the average vehicle operation costs can be utilized with confidence. Therefore, of the 38 runs reported on the data sheets, 20 runs were analyzed by means of average vehicle operation costs. Consequently, the need for computer runs appears to have been eliminated, at least for the Savannah data. This also eliminates significant costs for computer runs (including card punch times). Finally, if it is considered desirable, one or two computer runs could be accomplished for several typical floating vehicle runs, utilizing the RUNCOST program, at a minor cost. This would permit explicit comparison between the computer results and the detailed vehicle operation costs and the average vehicle operation costs.

4. The resultant data for vehicle operation costs and congestion costs have been listed in the Appendix on formatted data sheets. There are a total of 38 runs listed. For each data sheet, auxiliary data for the run are listed: such as the peak period time of the run and the date the street, direction of flow, and the street interval; the distance of the run and the time extent of the run; the average speed and the appropriate volume count. The estimated costs are listed in four categories as follows:

a. The detailed vehicle operation cost occurs first and is applicable only to 18 example runs. The several cost items which comprise the operation costs are listed as time cost, run cost, and speed change cost. The operation cost is listed as $/run and as $/VM.

b. The average vehicle operation cost occurs second. The several cost items which comprise the average operation cost are similar to those listed above for item a.

c. The standard vehicle operation cost occurs third. This value, of course, is fixed at $0.1577/VM and is the same for all runs. Note, however, that the standard cost for a run must be obtained by multiplying the standard cost per vehicle mile by the mileage distance of the run.

d. Finally, the congestion cost for the run is listed as $/VM.

5. For the 38 runs listed in the Appendix, the PM peak period data are listed first, followed by the AM peak period data. The runs include the following street intervals (and sub-intervals in some cases).

a. West Broad, north and southbound, Bay to Victory, with sub-intervals.

b. Montgomery, northbound, Victory to Bay, and southbound, Taylor to Victory.

c. Whitaker, southbound, Bay to Victory

d. Abercorn - Drayton, northbound, Victory to Bay.

e. Price, southbound, Bay to Victory.

f. East Broad - Wheaton, southbound, Bay to Waters.

g. Waters, north and southbound, Victory - Bay, via Wheaton and East Broad.

h. Bay, east and westbound, East Broad - Fahm, with sub-intervals.

k. Oglethorpe, westbound, Houston to West Broad.

j. Henry, westbound, East Broad to West Broad.

k. Anderson, eastbound, West Broad to Waters, with sub-intervals.

l. Victory, east and westbound, West Broad - Waters, with sub-intervals.

E. Data Analyses for a Projected Cost Benefit

1. As has been mentioned, the vehicle operation costs and congestion costs relate to the specified street intervals. These street intervals may or may not be directly related to particular work-trip routes. Nevertheless, for the sake of completeness, an attempt has been made to ascertain an average (modal) work-trip within the boundary area. Also, an average congestion cost has been developed. From these developed values it is possible to estimate a possible cost benefit for the computerized traffic control system. The procedures are discussed in the following paragraphs of this section.

2. The various work-trip routes are necessarily restricted to lie within the boundary area, i.e., distances traveled outside of the boundary area are not considered. Also, it is assumed that all traffic is destined for (or passes through) the CBD. Finally, the center of the CBD is arbitrarily defined as the intersection of Liberty and Abercorn Streets. Therefore, all travel distances and vehicle volumes will be related to this center of the CBD.

3. The average distances for the different directions of travel to the CBD center are accessed as follows:

a. For traffic flow in the area north of Liberty, it is assumed that all east-west traffic must traverse a distance of 3600 feet (0.682 miles), which is the average distance between the east-west extremities of the study area and Abercorn Street. Also, for this same traffic, it is assumed that the north-south flow must traverse an average distance of 1178 feet to 0.223 miles), which is half the distance from Bay to Liberty.

b. For traffic flow in the area south of Liberty, which traffic occurs from the regions east and west of the boundary area, it is assumed that the east-west flow must traverse a distance of 3600 feet (0.682 miles). Also, for this same traffic, it is assumed that the north-south flow must traverse an average distance of 4253 feet (0.805 miles), which is half the distance from Victory to Liberty.

c. For traffic flow in the area south of Liberty, which traffic occurs from the regions south of the boundary area, it is assumed that the east-west flow must traverse an average distance of 1800 feet (0.341 miles), which is half the distance from the east-west extremities of the boundary to Abercorn Street. Also, for this same traffic, it is assumed that the north-south flow must traverse a distance of 8505 feet (1.611 miles), which is the average distance from Victory to Liberty.

4. From TOPICS data for the peak periods, it appears that about 2000 veh/hr occur in the area north of Liberty. For the area south of Liberty, about 4100 veh/hr occur from the regions east and west of the boundary area, and about 4300 veh/hr occur from the region south of the boundary area.

5. From the congestion cost data presented in the Appendix, the following results are obtained.

a. For the principal streets supporting north and southbound AM travel, the average congestion cost is $0.06/VM.

b. For the principal streets supporting east and westbound AM travel, the average congestion cost if $0.07/VM.

c. For the principal streets supporting north and southbound PM travel, the average congestion cost is $0.07/VM.

d. For the principal streets supporting east and westbound PM travel, the average congestion cost is $0.21/VM.

6. An estimate of the total congestion cost for the CBD area can be obtained by calculating the appropriate products from the average values listed above in paragraphs 3, 4, and 5.

a. For the area north of Liberty:

(1) The congestion cost for east-west AM traffic is the product of 0.682 miles x 2200 veh/hr x $0.07/VM, or $105.

(2) The congestion cost for north-south AM traffic is the product of 0.223 miles x 2200 veh/hr x $0.07/VM, or $29.

(3) The congestion cost for east-west PM traffic is the product of 0.682 miles x 2200 veh/hr x $0.21/VM, or $315.

(4) The congestion cost for north-south PM traffic is the product of 0.223 miles x 2200 veh/hr x $0.07/VM, or $34.

b. Similarly, for the area south of Liberty, for traffic occurring from the regions east and west of the boundary area:

(1) AM congestion cost, east-west flow (0.682 x 4100 x 0.07) = $196.

(2) AM congestion cost, north-south flow (0.805 x 4100 x 0.06) = $198.

(3) PM congestion cost, east-west flow (0.682 x 4100 x 0.21) = $587.

(4) PM congestion cost, north-south flow (0.805 x 4100 x 0.07) = $231.

c. Similarly, for the area south of Liberty, for traffic occurring from the regions south of the boundary area:

(1) AM congestion cost, east-west flow (0.341 x 4300 x 0.07) = $103.

(2) AM congestion cost, north-south flow (1.611 x 4300 x 0.06) = $416.

(3) PM congestion cost, east-west flow (0.341 x 4300 x 0.21) = $308.

(4) PM congestion cost, north-south flow (1.611 x 4300 x 0.07) = $485.

d. The total estimated congestion cost per working day for peak AM and PM travel is the sum of the individual congestion costs listed above, or $3007/working day. On the basis of 5 working days per week, the yearly congestion cost is estimated as $781,820.

7. Finally, it is noted that if the average congestion costs could be reduced to about $0.05/VM for those particular streets where current congestion costs are greater than this amount, then the estimated total congestion cost per working day would be reduced to $1541. If this reduction could be realized, the yearly congestion cost would be reduced to $400,660. The projected cost benefit would then be $381,160 per working year (i.e., the difference between $781,820 and $400,660). Thus, the cost of the computerized traffic control system could be amortized in about 2 years!

8. It should be emphasized that the assumed reduction in congestion costs to the value of $0.05/VM is not unrealistic. In the previous Section C, paragraph 8, it has already been demonstrated that the congestion cost

on West Broad, southbound between Bay and Anderson, could be reduced from $0.22/run to $0.03/run. In addition the current congestion costs for such streets as Whitaker, Price, and Abercorn-Drayton average about $0.04/VM. This latter value results primarily because of the current traffic signal timing along these streets. Therefore, it does not appear to be unreasonable to assume that improved traffic signal timing on such streets as Bay, Oglethorpe, Wheaton, Anderson, Henry, and Victory could lower their current congestion costs to at least $0.05/VM.

F. Conclusions

1. The estimated vehicle operation costs and congestion costs for 38 street intervals have been summarized in the Appendix for the principal traffic flows in the CBD area of Savannah, Georgia. Generally, the results indicate that improvements may be accomplished on all of the street intervals which have been analyzed.

2. The congestion costs vary from about $0.01/VM to as high as $0.70/VM. Obviously, very little improvement, if any, may be realized on those streets with the smaller congestion costs. The average congestion cost for all runs (including both directions for both AM and PM periods) is about $0.09/VM.

3. The average congestion cost for the PM period of travel ($0.14/VM) is significantly higher than that for the AM period ($0.07/VM). Excessive congestion and higher congestion costs (greater than $0.10/VM) were observed primarily for the PM travel period on West Broad, southbound; Bay, east and westbound; Oglethorpe, westbound; and on Anderson, eastbound. To a lesser extent (congestion costs greater than $0.08/VM), congestion was noted on East Broad-Wheaton, southbound from Bay to Liberty and southeast-bound on Wheaton to Waters; Henry, westbound; and Victory, east and westbound. The excessive congestion noted on Oglethorpe, westbound, results from several circumstances:

a. There is a fairly high volume count of westbound vehicles (800 veh/hr) on Oglethorpe which are often restricted to single lane flow between Mont-gomery and West Broad because of curb lane parking in this interval.

b. There are a sufficient number of left-turning vehicles from Montgomery to Oglethorpe, westbound, such that these vehicles tend to fill the short storage space on Oglethorpe (between Montgomery and West Broad), often for several cycles of the current traffic light pattern. This further impedes the traffic flow for westbound vehicles on Oglethorpe which ingress from the east of the Montgomery intersection.

c. There is a fairly high left-turn volume (280 veh/hr) for vehicles exiting from Oglethorpe to West Broad, southbound. When the West Broad southbound flow is stopped, this left-turning traffic "back-logs" on Oglethorpe eastward from the Montgomery intersection.

d. It is believed that this "bottle neck" on Oglethorpe can be eliminated by appropriate traffic signal timing.

4. For the AM period, congestions were noted on Montgomery, northbound from the expressway, and on Victory, east and westbound. The congestion costs generally exceed $0.08/VM.

APPENDIX

Data Summary of Vehicle Operation Costs and Congestion Costs

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 5:16 PM , June 27 , 1973

STREET	DIRECTION	INTERVAL
West Broad	S.B.	Bay to Victory

DISTANCE	TOTAL TIME
10,991 ft.	622 sec.

AVERAGE SPEED

12.0 mph

AVERAGE VEHICLES PER PEAK HOUR

765 v/hr

ESTIMATED COSTS

Time Cost*	$0.4167
Detailed Run Cost**	0.0835
Detailed Change Speed Cost**	0.0800
Detailed Vehicle Operation Cost/run	$0.5802
Detailed Vehicle Operation Cost/VM	$0.2790
Time Cost	$0.4167
Average Run Cost	0.0882
Average Change Speed Cost	0.0777
Average Vehicle Operation Cost/run	$0.5826
Average Vehicle Operation Cost/VM	$0.2801
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.1213

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 5:05 PM, June 14, 1973

STREET	DIRECTION	INTERVAL
West Broad	S.B.	Bay to Anderson

DISTANCE	TOTAL TIME
7137 ft.	482 sec.

AVERAGE SPEED

10.1 mph

AVERAGE VEHICLES PER PEAK HOUR

818 v/hr

ESTIMATED COSTS

Time Cost*	$0.3229
Detailed Run Cost**	0.0516
Detailed Change Speed Cost**	0.0618
Detailed Vehicle Operation Cost/run	$0.4363
Detailed Vehicle Operation Cost/VM	$0.3232
Time Cost	$0.3229
Average Run Cost	0.0606
Average Change Speed Cost	0.0601
Average Vehicle Operation Cost/run	$0.4436
Average Vehicle Operation Cost/VM	$0.3286
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.1655

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 4:52 PM, June 11, 1973

STREET	DIRECTION	INTERVAL
West Broad	S.B.	Bay to Victory

DISTANCE	TOTAL TIME
10,991 ft.	424 sec.

AVERAGE SPEED

17.7 mph

AVERAGE VEHICLES PER PEAK HOUR

765 v/hr

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

ESTIMATED COSTS

Time Cost*	$0.2841
Detailed Run Cost**	0.0810
Detailed Change Speed Cost**	0.0557
Detailed Vehicle Operation Cost/run	$0.4208
Detailed Vehicle Operation Cost/VM	$0.2023
Time Cost	$0.2841
Average Run Cost	0.0791
Average Change Speed Cost	0.0405
Average Vehicle Operation Cost/run	$0.4037
Average Vehicle Operation Cost/VM	$0.1941
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.0446

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 5:00 PM, June 11, 1973

STREET	DIRECTION	INTERVAL
West Broad	N.B.	Victory to Bay

DISTANCE	TOTAL TIME
10,991 ft.	422 sec.

AVERAGE SPEED

17.8 mph

AVERAGE VEHICLES PER PEAK HOUR

435 v/hr

ESTIMATED COSTS

Time Cost*	$0.
Detailed Run Cost**	0.
Detailed Change Speed Cost**	0.
Detailed Vehicle Operation Cost/run	$0.
Detailed Vehicle Operation Cost/VM	$0.
Time Cost	$0.2827
Average Run Cost	0.0790
Average Change Speed Cost	0.0595
Average Vehicle Operation Cost/run	$0.4212
Average Vehicle Operation Cost/VM	$0.2025
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.0448

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 4:50 PM, June 12, 1973

STREET	DIRECTION	INTERVAL
Montgomery	N.B.	Victory to Bay

DISTANCE	TOTAL TIME
11,056 ft.	417 sec.

AVERAGE SPEED

18.1 mph

AVERAGE VEHICLES PER PEAK HOUR

471 v/hr

ESTIMATED COSTS

Time Cost*	$0.
Detailed Run Cost**	0.
Detailed Change Speed Cost**	0.
Detailed Vehicle Operation Cost/run	$0.
Detailed Vehicle Operation Cost/VM	$0.
Time Cost	$0.2794
Average Run Cost	0.0790
Average Change Speed Cost	0.0509
Average Vehicle Operation Cost/run	$0.4093
Average Vehicle Operation Cost/VM	$0.1958
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.0381

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 4:20 PM, June 12, 1973

STREET	DIRECTION	INTERVAL
Montgomery	S. B.	Taylor to Victory

DISTANCE	TOTAL TIME
7523 ft.	306 sec.

AVERAGE SPEED

16.8 mph

AVERAGE VEHICLES PER PEAK HOUR

328 v/hr

ESTIMATED COSTS

Time Cost*	$0.
Detailed Run Cost**	0.
Detailed Change Speed Cost**	0.
Detailed Vehicle Operation Cost/run	$0.
Detailed Vehicle Operation Cost/VM	$0.
Time Cost	$0.2050
Average Run Cost	0.0551
Average Change Speed Cost	0.0331
Average Vehicle Operation Cost/run	$0.2932
Average Vehicle Operation Cost/VM	$0.2058
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.0481

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 5:16 PM, June 12, 1973

STREET	DIRECTION	INTERVAL
Whitaker	S.B.	Bay to Victory

DISTANCE	TOTAL TIME
11,056 ft.	388 sec.

AVERAGE SPEED

19.4 mph

AVERAGE VEHICLES PER PEAK HOUR

873 v/hr

ESTIMATED COSTS

Time Cost*	$0.2600
Detailed Run Cost**	0.0802
Detailed Change Speed Cost**	0.0665
Detailed Vehicle Operation Cost/run	$0.4067
Detailed Vehicle Operation Cost/VM	$0.1946
Time Cost	$0.2600
Average Run Cost	0.0779
Average Change Speed Cost	0.0526
Average Vehicle Operation Cost/run	$0.3905
Average Vehicle Operation Cost/VM	$0.1868
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.0369

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 4:54 PM June 26, 1973

STREET	DIRECTION	INTERVAL
Price	S.B.	Bay to Victory

DISTANCE	TOTAL TIME
10,925 ft.	421 sec.

AVERAGE SPEED

17.7 mph

AVERAGE VEHICLES PER PEAK HOUR

811 v/hr

ESTIMATED COSTS

Time Cost*	$0.2821
Detailed Run Cost**	0.0771
Detailed Change Speed Cost**	0.0569
Detailed Vehicle Operation Cost/run	$0.4161
Detailed Vehicle Operation Cost/VM	$0.2011
Time Cost	$0.2821
Average Run Cost	0.0786
Average Change Speed Cost	0.0566
Average Vehicle Operation Cost/run	$0.4173
Average Vehicle Operation Cost/VM	$0.2017
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.0434

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 5:16 PM, June 28, 1973

STREET	DIRECTION	INTERVAL
East Broad-Wheaton	S.E.B.	Bay to Liberty, Wheaton to Waters

DISTANCE	TOTAL TIME	ESTIMATED COSTS
6254 ft.	326 sec.	

AVERAGE SPEED

13.1 mph

Time Cost*	$0.2184
Detailed Run Cost**	0.0470
Detailed Change Speed Cost**	0.0434
Detailed Vehicle Operation Cost/run	$0.3088
Detailed Vehicle Operation Cost/VM	$0.2608

AVERAGE VEHICLES PER PEAK HOUR

606 v/hr

Time Cost	$0.2184
Average Run Cost	0.0485
Average Change Speed Cost	0.0419
Average Vehicle Operation Cost/run	$0.3088
Average Vehicle Operation Cost/VM	$0.2608

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.1031

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 4:06 PM, June 29, 1973

STREET	DIRECTION	INTERVAL
Waters	S.B.	Bay to Victory, via E. Broad and Wheaton

DISTANCE	TOTAL TIME
12,731 ft.	446 sec.

AVERAGE SPEED

19.5 mph

AVERAGE VEHICLES PER PEAK HOUR

418 v/hr

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

ESTIMATED COSTS

Time Cost*	$0.2988
Detailed Run Cost**	0.0898
Detailed Change Speed Cost**	0.0461
Detailed Vehicle Operation Cost/run	$0.4347
Detailed Vehicle Operation Cost/VM	$0.1803
Time Cost	$0.2988
Average Run Cost	0.0897
Average Change Speed Cost	0.0393
Average Vehicle Operation Cost/run	$0.4278
Average Vehicle Operation Cost/VM	$0.1774
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.0226

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 4:45 PM, June 13, 1973

STREET	DIRECTION	INTERVAL
Waters	N.B.	Victory to E. Broad, via Wheaton

DISTANCE	TOTAL TIME
10,402 ft.	466 sec.

AVERAGE SPEED

15.2 mph

AVERAGE VEHICLES PER PEAK HOUR

372 v/hr

ESTIMATED COSTS

Time Cost*	$0.
Detailed Run Cost**	0.
Detailed Change Speed Cost**	0.
Detailed Vehicle Operation Cost/run	$0.
Detailed Vehicle Operation Cost/VM	$0.
Time Cost	$0.3122
Average Run Cost	0.0780
Average Change Speed Cost	0.0716
Average Vehicle Operation Cost/run	$0.4618
Average Vehicle Operation Cost/VM	$0.2344
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.0767

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 5:06 PM, June 11, 1973

STREET	DIRECTION	INTERVAL
Bay	E.B.	W. Broad to E. Broad
DISTANCE	TOTAL TIME	ESTIMATED COSTS
4252 ft.	339 sec.	

AVERAGE SPEED

8.6 mph

AVERAGE VEHICLES PER PEAK HOUR

1035 v/hr

	Time Cost*	$0.2271
	Detailed Run Cost**	0.0440
	Detailed Change Speed Cost**	0.0306
Detailed	Vehicle Operation Cost/run	$0.3017
Detailed	Vehicle Operation Cost/VM	$0.3748
	Time Cost	$0.2271
	Average Run Cost	0.0383
	Average Change Speed Cost	0.0283
Average	Vehicle Operation Cost/run	$0.2937
Average	Vehicle Operation Cost/VM	$0.3648
	Standard Vehicle Operation Cost/VM	$0.1577
	Congestion Cost/VM	$0.2171

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 5:09 PM, June 27, 1973

STREET	DIRECTION	INTERVAL
Bay	W.B.	E. Broad to W. Broad

DISTANCE	TOTAL TIME
4252 ft.	232 sec.

AVERAGE SPEED

12.5 mph

AVERAGE VEHICLES PER PEAK HOUR

600 v/hr

ESTIMATED COSTS

Time Cost*	$0.
Detailed Run Cost**	0.
Detailed Change Speed Cost**	0.
Detailed Vehicle Operation Cost/run	$0.
Detailed Vehicle Operation Cost/VM	$0.
Time Cost	$0.1554
Average Run Cost	0.0336
Average Change Speed Cost	0.0249
Average Vehicle Operation Cost/run	$0.2139
Average Vehicle Operation Cost/VM	$0.2658
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.1081

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 3:45 PM, June 27, 1973

STREET	DIRECTION	INTERVAL
Bay	E.B.	Fahm to E. Broad

DISTANCE	TOTAL TIME
5253 ft.	204 sec.

AVERAGE SPEED

17.6 mph

AVERAGE VEHICLES PER PEAK HOUR

1035 v/hr

ESTIMATED COSTS

Time Cost*	$0.1367
Detailed Run Cost**	0.0380
Detailed Change Speed Cost**	0.0382
Detailed Vehicle Operation Cost/run	$0.2129
Detailed Vehicle Operation Cost/VM	$0.2140
Time Cost	$0.1367
Average Run Cost	0.0379
Average Change Speed Cost	0.0325
Average Vehicle Operation Cost/run	$0.2071
Average Vehicle Operation Cost/VM	$0.2082
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.0563

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 5:22 PM, June 29, 1973

STREET	DIRECTION	INTERVAL
Oglethorpe	W.B.	Houston to W. Broad

DISTANCE	TOTAL TIME
3892 ft.	835 sec.

AVERAGE SPEED

3.2 mph

AVERAGE VEHICLES PER PEAK HOUR

494 v/hr

ESTIMATED COSTS

Time Cost*	$0.5595
Detailed Run Cost**	0.0496
Detailed Change Speed Cost**	0.0276
Detailed Vehicle Operation Cost/run	$0.6367
Detailed Vehicle Operation Cost/VM	$0.8638
Time Cost	$0.5595
Average Run Cost	0.0535
Average Change Speed Cost	0.0276
Average Vehicle Operation Cost/run	$0.6406
Average Vehicle Operation Cost/VM	$0.8692
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.7061

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 5:18 PM, June 25 1973

STREET	DIRECTION	LIMITS
Anderson	E.B.	W. Broad to Waters
DISTANCE	TOTAL TIME	ESTIMATED COSTS
7320 ft.	372 sec.	

AVERAGE SPEED

13.4 mph

AVERAGE VEHICLES PER PEAK HOUR

770 v/hr

Time Cost*	$0.2492
Detailed Run Cost**	0.0547
Detailed Change Speed Cost**	0.0458
Detailed Vehicle Operation Cost/run	$0.3497
Detailed Vehicle Operation Cost/VM	$0.2573
Time Cost	$0.2492
Average Run Cost	0.0563
Average Change Speed Cost	0.0334
Average Vehicle Operation Cost/run	$0.3389
Average Vehicle Operation Cost/VM	$0.2445
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.0946

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 5:18 PM, June 25, 1973

STREET	DIRECTION	INTERVAL
Anderson	E.B.	W. Broad to E. Broad

DISTANCE	TOTAL TIME
4257 ft.	235 sec.

AVERAGE SPEED

12.3 mph

AVERAGE VEHICLES PER PEAK HOUR

763 v/hr

ESTIMATED COSTS

Time Cost*	$0.1575
Detailed Run Cost**	0.0326
Detailed Change Speed Cost**	0.0288
Detailed Vehicle Operation Cost/run	$0.2189
Detailed Vehicle Operation Cost/VM	$0.2719
Time Cost	$0.1575
Average Run Cost	0.0337
Average Change Speed Cost	0.0212
Average Vehicle Operation Cost/run	$0.2124
Average Vehicle Operation Cost/VM	$0.2639
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.1142

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 4:48 PM, June 25, 1973

STREET	DIRECTION	INTERVAL
Henry	W.B.	Waters to W. Broad

DISTANCE	TOTAL TIME
7320 ft.	340 sec.

AVERAGE SPEED

14.7 mph

AVERAGE VEHICLES PER PEAK HOUR

539 v/hr

ESTIMATED COSTS

Time Cost*	$0.2278
Detailed Run Cost**	0.0525
Detailed Change Speed Cost**	0.0427
Detailed Vehicle Operation Cost/run	$0.3230
Detailed Vehicle Operation Cost/VM	$0.2330
Time Cost	$0.2278
Average Run Cost	0.0553
Average Change Speed Cost	0.0360
Average Vehicle Operation Cost/run	$0.3191
Average Vehicle Operation Cost/VM	$0.2302
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.0753

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 4:48 PM , June 25, 1973

STREET	DIRECTION	INTERVAL
Henry	W.B.	E. Broad to W. Broad

DISTANCE	TOTAL TIME
4252 ft.	232 sec.

AVERAGE SPEED

12.5 mph

AVERAGE VEHICLES PER PEAK HOUR

570 v/hr

ESTIMATED COSTS

Time Cost*	$0.1554
Detailed Run Cost**	0.0316
Detailed Change Speed Cost**	0.0264
Detailed Vehicle Operation Cost/run	$0.2134
Detailed Vehicle Operation Cost/VM	$0.2651
Time Cost	$0.1554
Average Run Cost	0.0430
Average Change Speed Cost	0.0185
Average Vehicle Operation Cost/run	$0.2169
Average Vehicle Operation Cost/VM	$0.2694
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.1074

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 4:10 PM, June 26, 1973

STREET	DIRECTION	INTERVAL
Victory	E.B.	W. Broad to Waters

DISTANCE	TOTAL TIME
7399 ft.	362 sec.

AVERAGE SPEED

13.9 mph

AVERAGE VEHICLES PER PEAK HOUR

713 v/hr

ESTIMATED COSTS

Time Cost*	$0.2425
Detailed Run Cost**	0.0543
Detailed Change Speed Cost**	0.0603
Detailed Vehicle Operation Cost/run	$0.3571
Detailed Vehicle Operation Cost/VM	$0.2551
Time Cost	$0.2425
Average Run Cost	0.0563
Average Change Speed Cost	0.0574
Average Vehicle Operation Cost/run	$0.3562
Average Vehicle Operation Cost/VM	$0.2544
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.0974

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 4:40 PM, June 13, 1973

STREET	DIRECTION	INTERVAL
Victory	E. B.	W. Broad to Waters
DISTANCE	TOTAL TIME	ESTIMATED COSTS
7399 ft.	348 sec.	

AVERAGE SPEED

14.5 mph

AVERAGE VEHICLES PER PEAK HOUR

713 v/hr

Time Cost*	$0.2332
Detailed Run Cost**	0.0557
Detailed Change Speed Cost**	0.0513
Detailed Vehicle Operation Cost/run	$0.3402
Detailed Vehicle Operation Cost/VM	$0.2430
Time Cost	$0.2332
Average Run Cost	0.0560
Average Change Speed Cost	0.0504
Average Vehicle Operation Cost/run	$0.3396
Average Vehicle Operation Cost/VM	$0.2426
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.0853

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 4:37 , June 26 , 1973

STREET	DIRECTION	INTERVAL
Victory	W.B.	Waters to W. Broad

DISTANCE	TOTAL TIME
7399 ft.	309 sec.

AVERAGE SPEED

16.3 mph

AVERAGE VEHICLES PER PEAK HOUR

644 v/hr

ESTIMATED COSTS

Time Cost*	$0.2070
Detailed Run Cost**	0.0619
Detailed Change Speed Cost**	0.0544
Detailed Vehicle Operation Cost/run	$0.3233
Detailed Vehicle Operation Cost/VM	$0.2310
Time Cost	$0.2070
Average Run Cost	0.0545
Average Change Speed Cost	0.0544
Average Vehicle Operation Cost/run	$0.3159
Average Vehicle Operation Cost/VM	$0.2256
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.0733

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 4:31, June 13, 1973

STREET	DIRECTION	INTERVAL
Victory	W.B.	Price to W. Broad

DISTANCE	TOTAL TIME
3637 ft.	188 sec.

AVERAGE SPEED

13.2 mph

AVERAGE VEHICLES PER PEAK HOUR

571 v/hr

ESTIMATED COSTS

Time Cost*	$0.1260
Detailed Run Cost**	0.0279
Detailed Change Speed Cost**	0.0242
Detailed Vehicle Operation Cost/run	$0.1781
Detailed Vehicle Operation Cost/VM	$0.2584
Time Cost	$0.1260
Average Run Cost	0.0281
Average Change Speed Cost	0.0226
Average Vehicle Operation Cost/run	$0.1767
Average Vehicle Operation Cost/VM	$0.2565
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.1007

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 7:46 AM, June 12, 1973

STREET	DIRECTION	INTERVAL
West Broad	N.B.	Victory to Bay

DISTANCE	TOTAL TIME	ESTIMATED COSTS
10,991 ft.	454 sec.	

AVERAGE SPEED

16.5 mph

AVERAGE VEHICLES PER PEAK HOUR

367 v/hr

Time Cost*	$0.
Detailed Run Cost**	0.
Detailed Change Speed Cost**	0.
Detailed Vehicle Operation Cost/run	$0.
Detailed Vehicle Operation Cost/VM	$0.
Time Cost	$0.3042
Average Run Cost	0.0808
Average Change Speed Cost	0.0637
Average Vehicle Operation Cost/run	$0.4487
Average Vehicle Operation Cost/VM	$0.2157
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.0580

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 8:00 AM, June 12, 1973

STREET	DIRECTION	INTERVAL
West Broad	S.B.	Bay to Victory

DISTANCE	TOTAL TIME	ESTIMATED COSTS
10,991 ft.	404 sec.	

AVERAGE SPEED

18.5 mph

AVERAGE VEHICLES PER PEAK HOUR

364 v/hr

Time Cost*	$0.
Detailed Run Cost**	0.
Detailed Change Speed Cost**	0.
Detailed Vehicle Operation Cost/run	$0.
Detailed Vehicle Operation Cost/VM	$0.
Time Cost	$0.2707
Average Run Cost	0.0781
Average Change Speed Cost	0.0529
Average Vehicle Operation Cost/run	$0.4017
Average Vehicle Operation Cost/VM	$0.1931
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.0354

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 7:25 AM, June 29, 1973

STREET	DIRECTION	INTERVAL
Montgomery	N.B.	Exchange to Bay

DISTANCE	TOTAL TIME
12,495 ft.	407 sec.

AVERAGE SPEED

20.9 mph

AVERAGE VEHICLES PER PEAK HOUR

594 v/hr

ESTIMATED COSTS

Time Cost*	$0.
Detailed Run Cost**	0.
Detailed Change Speed Cost**	0.
Detailed Vehicle Operation Cost/run	$0.
Detailed Vehicle Operation Cost/VM	$0.
Time Cost	$0.2727
Average Run Cost	0.0870
Average Change Speed Cost	0.0447
Average Vehicle Operation Cost/run	$0.4044
Average Vehicle Operation Cost/VM	$0.1709
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.0132

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 7:47 AM, June 29, 1973

STREET	DIRECTION	INTERVAL
Montgomery	N.B.	Gaston to Bay
DISTANCE	TOTAL TIME	ESTIMATED COSTS
4121 ft.	216 sec.	
AVERAGE SPEED		Time Cost* $0.
13.0 mph		Detailed Run Cost** 0.
		Detailed Change Speed Cost** 0.
		Detailed Vehicle Operation Cost/run $0.
AVERAGE VEHICLES		Detailed Vehicle Operation Cost/VM $0.
PER PEAK HOUR		Time Cost $0.1447
828 v/hr		Average Run Cost 0.0320
		Average Change Speed Cost 0.0329
		Average Vehicle Operation Cost/run $0.2096
		Average Vehicle Operation Cost/VM $0.2687
* for all Time Costs 1.6 occupants/vehicle 1.50/hour/occupant		Standard Vehicle Operation Cost/VM $0.1577
** all Run Costs and all Change Speed Costs from Winfrey's tables		Congestion Cost/VM $0.1110

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 8:02 AM, June 27, 1973

STREET	DIRECTION	INTERVAL
Abercorn-Drayton	N.B.	Victory to Bay

DISTANCE	TOTAL TIME
11318 ft.	386 sec.

AVERAGE SPEED

20.0 mph

AVERAGE VEHICLES PER PEAK HOUR

1065 v/hr

ESTIMATED COSTS

Time Cost*	$0.
Detailed Run Cost**	0.
Detailed Change Speed Cost**	0.
Detailed Vehicle Operation Cost/run	$0.
Detailed Vehicle Operation Cost/VM	$0.
Time Cost	$0.2586
Average Run Cost	0.0795
Average Change Speed Cost	0.0794
Average Vehicle Operation Cost/run	$0.4175
Average Vehicle Operation Cost/VM	$0.1948
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.0371

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 7:57 AM, June 14, 1973

STREET	DIRECTION	INTERVAL
Waters	N.B.	Victory to Randolph, via Wheaton

DISTANCE	TOTAL TIME	ESTIMATED COSTS
9617 ft.	396 sec.	

AVERAGE SPEED

16.6 mph

Time Cost*	$0.
Detailed Run Cost**	0.
Detailed Change Speed Cost**	0.
Detailed Vehicle Operation Cost/run	$0.
Detailed Vehicle Operation Cost/VM	$0.

AVERAGE VEHICLES PER PEAK HOUR

374 v/hr

Time Cost	$0.2653
Average Run Cost	0.0706
Average Change Speed Cost	0.0471
Average Vehicle Operation Cost/run	$0.3830
Average Vehicle Operation Cost/VM	$0.2105

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.0528

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 7:50 AM, June 14, 1973

STREET	DIRECTION	INTERVAL
Victory	E.B.	W. Broad to Waters

DISTANCE	TOTAL TIME
7399 ft.	317 sec.

AVERAGE SPEED

15.9 mph

AVERAGE VEHICLES

. PER PEAK HOUR

523 v/hr

ESTIMATED COSTS

Time Cost*	$0.
Detailed Run Cost**	0.
Detailed Change Speed Cost**	0.
Detailed Vehicle Operation Cost/run	$0.
Detailed Vehicle Operation Cost/VM	$0.
Time Cost	$0.2124
Average Run Cost	0.0549
Average Change Speed Cost	0.0524
Average Vehicle Operation Cost/run	$0.3197
Average Vehicle Operation Cost/VM	$0.2284
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.0707

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 7:59 AM, June 27, 1973

STREET	DIRECTION	INTERVAL
Victory	E.B.	W. Broad to Abercorn

DISTANCE	TOTAL TIME
1963 ft.	114 sec.

AVERAGE SPEED

11.7 mph

AVERAGE VEHICLES PER PEAK HOUR

484 v/hr

ESTIMATED COSTS

Time Cost*	$0.
Detailed Run Cost**	0.
Detailed Change Speed Cost**	0.
Detailed Vehicle Operation Cost/run	$0.
Detailed Vehicle Operation Cost/VM	$0.
Time Cost	$0.0764
Average Run Cost	0.0159
Average Change Speed Cost	0.0108
Average Vehicle Operation Cost/run	$0.1031
Average Vehicle Operation Cost/VM	$0.2771
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.1194

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs

from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 7:38 AM, June 27, 1973

STREET	DIRECTION	INTERVAL
Victory	W.B.	Waters to W. Broad

DISTANCE	TOTAL TIME
7399 ft.	312 sec.

AVERAGE SPEED

16.1 mph

AVERAGE VEHICLES PER PEAK HOUR

743 v/hr

ESTIMATED COSTS

Time Cost*	$0.
Detailed Run Cost**	0.
Detailed Change Speed Cost**	0.
Detailed Vehicle Operation Cost/run	$0.
Detailed Vehicle Operation Cost/VM	$0.
Time Cost	$0.2090
Average Run Cost	0.0547
Average Change Speed Cost	0.0530
Average Vehicle Operation Cost/run	$0.3167
Average Vehicle Operation Cost/VM	$0.2262
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.0685

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 8:14 AM, June 27, 1973

STREET	DIRECTION	INTERVAL
Victory	W.B.	Waters to Abercorn

DISTANCE	TOTAL TIME
4828 ft.	247 sec.

AVERAGE SPEED

13.3 mph

AVERAGE VEHICLES PER PEAK HOUR

978 v/hr

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

ESTIMATED COSTS

Time Cost*	$0.
Detailed Run Cost**	0.
Detailed Change Speed Cost**	0.
Detailed Vehicle Operation Cost/run	$0.
Detailed Vehicle Operation Cost/VM	$0.
Time Cost	$0.1655
Average Run Cost	0.0372
Average Change Speed Cost	0.0286
Average Vehicle Operation Cost/run	$0.2313
Average Vehicle Operation Cost/VM	$0.2531
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.0954

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 8:03 AM, June 25, 1973

STREET	DIRECTION	INTERVAL
Anderson	E.B.	W. Broad to E. Broad

DISTANCE	TOTAL TIME
4252 ft.	153 sec.

AVERAGE SPEED

18.9 mph

AVERAGE VEHICLES PER PEAK HOUR

376 v/hr

ESTIMATED COSTS

Time Cost*	$0.
Detailed Run Cost**	0.
Detailed Change Speed Cost**	0.
Detailed Vehicle Operation Cost/run	$0.
Detailed Vehicle Operation Cost/VM	$0.
Time Cost	$0.1025
Average Run Cost	0.0301
Average Change Speed Cost	0.0107
Average Vehicle Operation Cost/run	$0.1433
Average Vehicle Operation Cost/VM	$0.1780
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.0203

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 8:25 AM, June 15, 1973

STREET	DIRECTION	INTERVAL
Henry	W. B.	E. Broad to W. Broad

DISTANCE	TOTAL TIME	ESTIMATED COSTS
4252 ft.	191 sec.	

AVERAGE SPEED

15.2 mph

AVERAGE VEHICLES PER PEAK HOUR

732 v/hr

Time Cost*	$0.
Detailed Run Cost**	0.
Detailed Change Speed Cost**	0.
Detailed Vehicle Operation Cost/run	$0.
Detailed Vehicle Operation Cost/VM	$0.
Time Cost	$0.1280
Average Run Cost	0.0319
Average Change Speed Cost	0.0214
Average Vehicle Operation Cost/run	$0.1813
Average Vehicle Operation Cost/VM	$0.2252
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.0675

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 7:55 AM, June 12, 1973

STREET	DIRECTION	INTERVAL
Bay	E.B.	W. Broad to E. Broad

DISTANCE	TOTAL TIME
4252 ft.	202 sec.

AVERAGE SPEED

14.4 mph

AVERAGE VEHICLES PER PEAK HOUR

573 v/hr

ESTIMATED COSTS

Time Cost*	$0.
Detailed Run Cost**	0.
Detailed Change Speed Cost**	0.
Detailed Vehicle Operation Cost/run	$0.
Detailed Vehicle Operation Cost/VM	$0.
Time Cost	$0.1353
Average Run Cost	0.0323
Average Change Speed Cost	0.0273
Average Vehicle Operation Cost/run	$0.1949
Average Vehicle Operation Cost/VM	$0.2421
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.0844

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 7:11 AM, June 28, 1973

STREET	DIRECTION	INTERVAL
Bay	W.B.	E. Broad to Eahm

DISTANCE	TOTAL TIME	ESTIMATED COSTS
5253 ft.	183 sec.	

AVERAGE SPEED

19.6 mph

AVERAGE VEHICLES PER PEAK HOUR

710 v/hr

Time Cost*	$0.
Detailed Run Cost**	0.
Detailed Change Speed Cost**	0.
Detailed Vehicle Operation Cost/run	$0.
Detailed Vehicle Operation Cost/VM	$0.
Time Cost	$0.1226
Average Run Cost	0.0370
Average Change Speed Cost	0.0398
Average Vehicle Operation Cost/run	$0.1994
Average Vehicle Operation Cost/VM	$0.2004
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.0427

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables

SAVANNAH, GEORGIA

FLOATING VEHICLE DATA SUMMARY

Peak Period 8:28 AM , June 28 , 1973

STREET	DIRECTION	INTERVAL
Bay	W.B.	E. Broad to Fahm
DISTANCE	TOTAL TIME	ESTIMATED COSTS
5253 ft.	214 sec.	

AVERAGE SPEED

16.7 mph

AVERAGE VEHICLES PER PEAK HOUR

710 v/hr

Time Cost*	$0.
Detailed Run Cost**	0.
Detailed Change Speed Cost**	0.
Detailed Vehicle Operation Cost/run	$0.
Detailed Vehicle Operation Cost/VM	$0.
Time Cost	$0.1434
Average Run Cost	0.0372
Average Change Speed Cost	0.0352
Average Vehicle Operation Cost/run	$0.2158
Average Vehicle Operation Cost/VM	$0.2169
Standard Vehicle Operation Cost/VM	$0.1577
Congestion Cost/VM	$0.0592

* for all Time Costs
1.6 occupants/vehicle
1.50/hour/occupant

** all Run Costs and all Change Speed Costs from Winfrey's tables